Salmonella prevalence in market weight pigs before and after shipment to slaughter

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Samples commonly used for microbiological culture of subclinical *Salmonella* infection in market weight pigs include fecal material, mesenteric lymph nodes, cecal contents, rectal contents, and rectal swabs (1, 2, 4, 5). In epidemiologic investigations, collection of abattoir samples offers certain advantages over farm collected samples. Sampling at slaughter offers the advantage of a wider range of sample types. For practical reasons, samples collected on the farm for microbiological culture are usually limited to fecal samples, whereas slaughter samples can include lymph node and higher gut contents. The ease of collection at the slaughter plant facilitates sampling a large number of herds. Detection of *Salmonella* in slaughtered pigs is also a useful indicator of risk to pork safety, because slaughter processing is the primary point where direct risk of entry into the food chain exists. However, it is possible that pigs may become infected during transportation and lairage. Further, it is possible that pigs harbor *Salmonella* while on the farm, but they do not shed the organism into feces. The stress of events immediately pre-slaughter may then induce these non-shedding infected pigs to begin shedding.

Common samples for microbiological culture of *Salmonella* in market weight pigs are fecal material at the farm and mesenteric lymph nodes at slaughter (4, 5). Because of these potential differences in shedding rates between fecal samples at the farm and lymph node samples collected at the slaughter plant, it is difficult to compare studies that culture only one of these samples. We designed this study to describe and quantify the strength of the relationships between prevalence of *Salmonella* from feces collected before shipment to slaughter and lymph node prevalence of *Salmonella* at slaughter.

Materials And Methods

A large-scale field study was conducted in Illinois (USA) to evaluate prevalence of *Salmonella* from slaughter pigs at the herd-level (4). Caudal mesenteric lymph node samples were cultured from market weight pigs at slaughter from 141 herds, processed as pooled samples, and examined microbiologically for *Salmonella*. One or more positive culture result was found in 67.4 % (95/141) of herds. Among those herds marketing to one slaughter plant, 10 herds were randomly selected from negative herds and 20 randomly selected among positive herds, corresponding to the proportions of positive and negative herds.

Each herd was recruited for the study on the basis of the producer's voluntary participation, which was obtained via direct telephone contact. Sample collection was conducted over a 5-month period from December 1998 to April 1999. For each farm, pigs were randomly selected from among those pigs scheduled to be shipped to slaughter within four days. Fecal samples were collected by digital extraction from at least 30 pigs prior to shipment to slaughter. Lymph node samples from the same group of pigs, not necessarily from the same individual pig, were collected at slaughter. Fecal samples were transported on ice and then refrigerated until processing. Samples were normally cultured within 24 hours. The maximum allowable length of time between collection and culture was 96 hours (7).

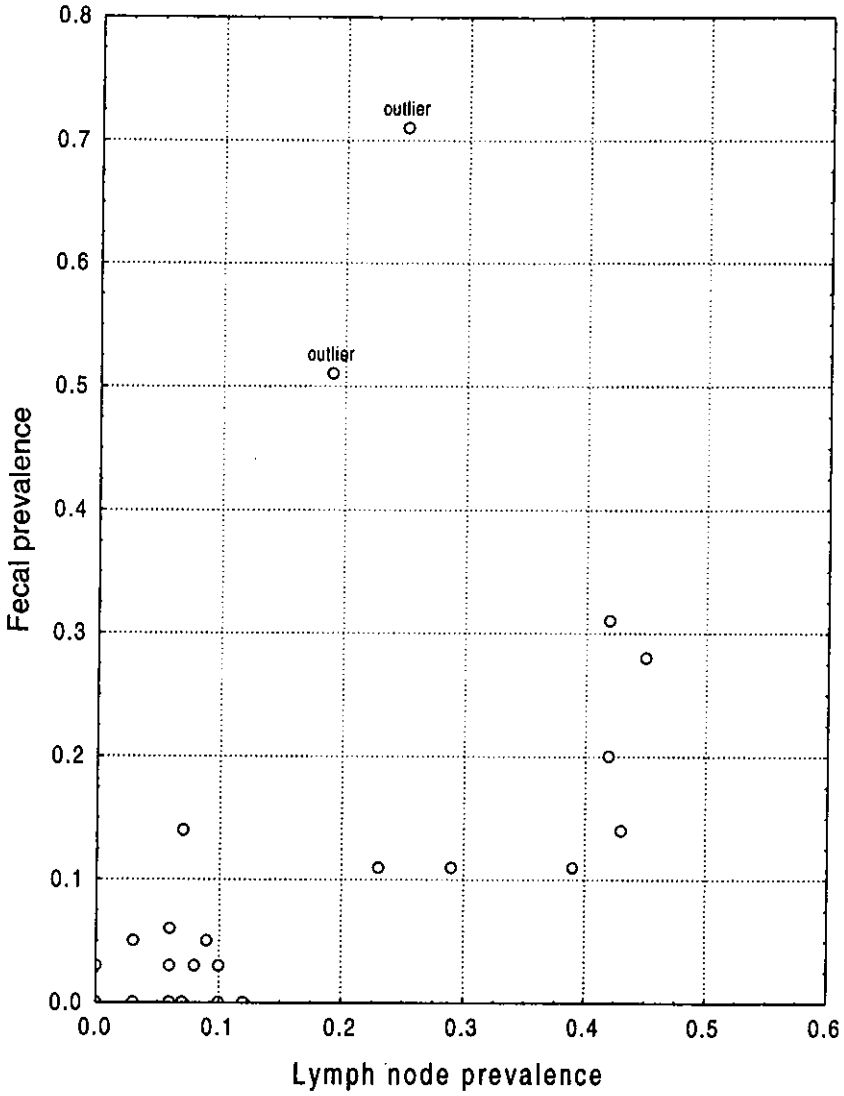
Both fecal and lymph node samples were cultured using a modification of existing methods (6). Briefly, 10 grams of sample were homogenized, then incubated in 100 ml tetrathionate broth at 37°C for 48 hours. One ml was then incubated in 10 ml Rappaport-Vassiliadis (RV) broth at 37°C for 18-24 hours. Ten µl of RV broth was streaked onto an XLT-4 (Xylose-Lysine- Tergitol-4) plate, then incubated at 37°C for 18-24 hours. A single suspect positive colony showing red color with a black center was transferred to a brilliant green agar (BGA) plate, incubated for 18-24 hours at 37°C. A red colony from the BGA plate was chosen as a candidate for *Salmonella* and tested for agglutination using *Salmonella* O antiserum. Suspect colonies negative on the serum agglutination test were further examined using the API 20E (BioMerieux Sa) identification system.

Linear correlation analysis was used to quantify the degree of association between lymph node prevalence at slaughter and fecal prevalence on the farm (3). Data was analyzed using a commercial statistical software package, with a = 0.05 (SAS version 6.12).

Results

From the 30 herds, fecal and lymph node samples were collected from 1,072 and 966 market weight pigs, respectively. *Salmonella spp.* were detected in 9.7% (106/1072) of fecal samples and 13.7% (132/966) of lymph node samples. The within-herd prevalence from fecal samples varied between 0% and 71.4%, with a median of 2.86 %. The within-herd prevalence for the lymph node samples varied between 0% and 44.8%, with a median of 6.67 %. The

Figure 1. Plot of fecal vs. lymph node prevalence among slaughter weight pigs from 30 Illinois farms



proportion of herds with one or more positive samples was 83.3 % (25/30) for lymph nodes and 43.3 % (13/30) for fecal samples. The linear correlation between lymph node and fecal prevalence was 0.57 ($p = 0.001$). Two outliers were identified (Figure 1). After removal of the outliers, the linear correlation was 0.86 ($p < 0.0001$).

Discussion

Farm samples are generally limited to fecal samples, because collection of higher GI or mesenteric lymph node samples is costly because pigs must be sacrificed. Feces have shown a lower *Salmonella* prevalence than lymph nodes (2). On-farm fecal collection also provides more variability in *Salmonella* prevalence than found in lymph nodes at slaughter, since sample collection and handling procedure are likely to vary on each farm. However, collection of lymph nodes at slaughter can be accomplished in a more consistent manner. Further, the greatest risk for contamination during processing comes from intestinal contents higher in the GI tract. The culture status of caudal mesenteric lymph nodes reflects infection in an important portion of the GI tract and suggests that the organism can invade, and thus may be a useful predictor of risk for food safety.

This study demonstrated a moderately strong association between *Salmonella* culture prevalence from feces collected at the farm and lymph node collected at slaughter. Thus, although either sample (lymph node or feces) may not accurately predict prevalence of the other sample on any individual farm, it may be possible to use one of the samples to draw inferences about the prevalence of the other sample among groups of farms. Stated another way, farms with high fecal prevalence tend to have high lymph node prevalence, but it is not possible to accurately predict the prevalence.

Two herds had large discrepancies between lymph node prevalence and fecal prevalence. For most herds in this study, lymph node prevalence was likely to be higher than fecal prevalence measured on each farm. For each of the two outlying data points, however, fecal prevalence was substantially increased compared to lymph node prevalence. For these reasons, these two observations were considered outliers. The occurrence of these extreme observations may have arisen from chance alone, although the probability of this is not high. Alternately, the outlying data points may suggest that these farms differed by some factors that influenced farm fecal prevalence separately from lymph node prevalence.

Quantifying the strength of this relationship between the prevalence of *Salmonella* in feces and that in mesenteric lymph nodes should be useful to those interested in comparing on-farm *Salmonella* prevalence to prevalence estimated at slaughter, and to those interested in predicting the risk to pork safety based on the fecal culture for *Salmonella*.

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